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ABIES
(*firs*)

F—490515

There are about 40 species of true firs (*Abies*), all native in the Northern Hemisphere. They grow in cool temperate regions and mountains southward to Guatemala, northern Africa, Himalayas, and Taiwan. Seven of the 9 species in the United States are important in forestry.

The trees usually have bark with resin blisters, afterwards usually furrowed. Fir needles are usually flattened or sometimes 4-angled, pointed or notched and are often spreading in 2 rows. They persist for 7 to 10 years.

Male and ovulate strobili develop on the same tree in spring from buds formed along twig growth of the previous year. The upright cylindrical or egg-shaped cones, mostly on topmost branches, mature in one season. They are composed of very many closely overlapping, thin scales. The seeds, usually paired at base of a scale, have broad wings and contain resin cavities. After the cone matures, the scales fall off, while the upright central axis remains on the twig through the winter. Cotyledons usually 5 to 7.

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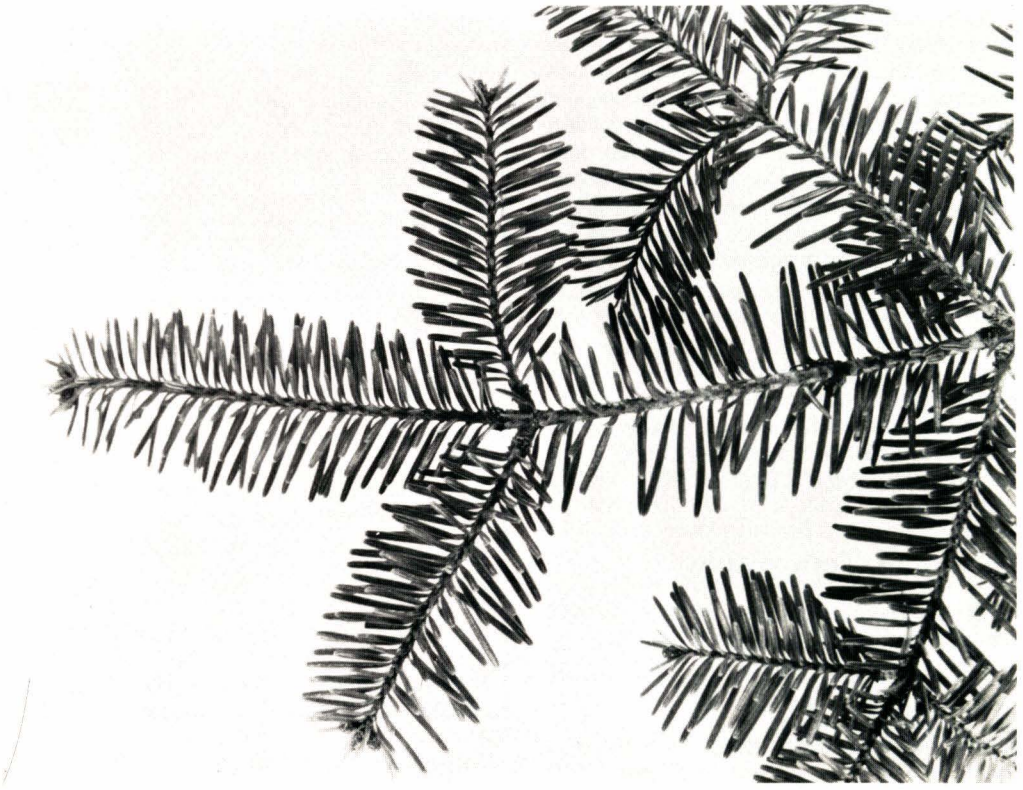


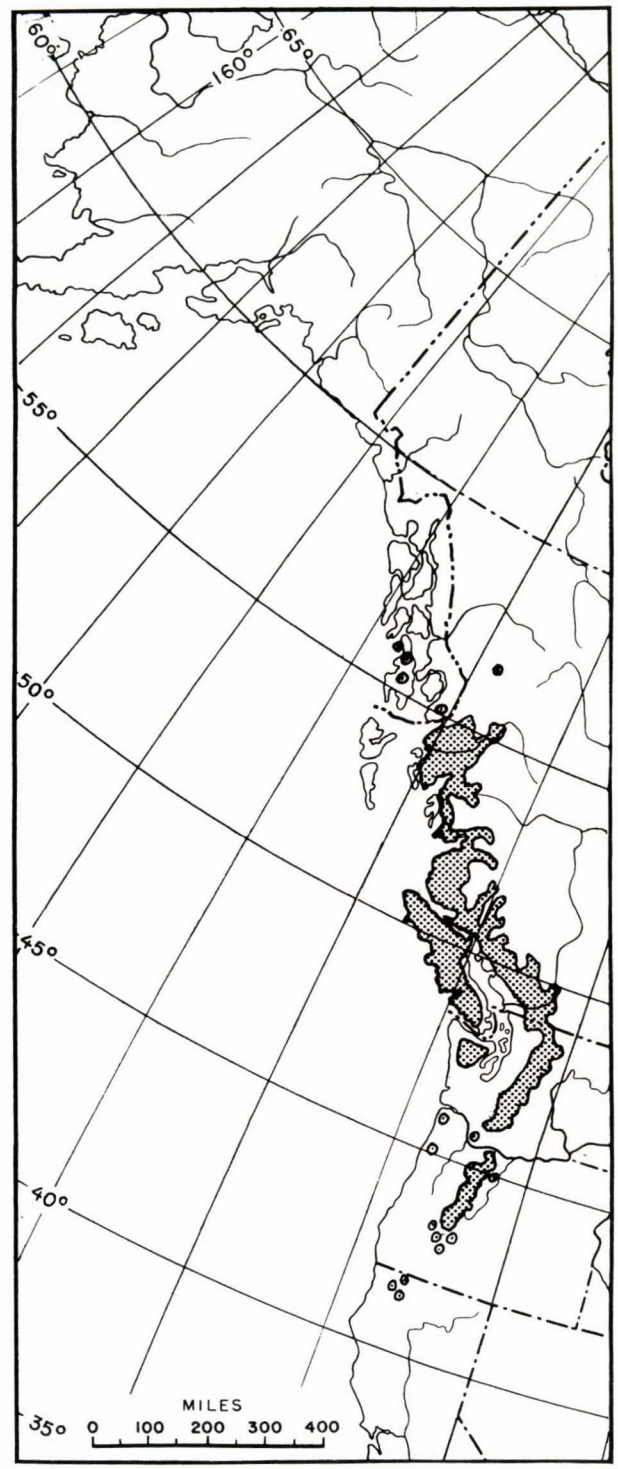
PACIFIC SILVER FIR (*Abies amabilis* (Dougl.) Forbes)

Other common names: Cascades fir, amabilis fir, lovely fir, red fir, silver fir, and white fir.

Pacific silver fir is among the most beautiful forest trees in the Pacific Northwest. One of its common names, lovely fir, forms the literal basis for the Latin derivation and is truly descriptive of the species.

Pacific silver fir grows from the southeastern edge of Alaska (55° N. latitude) south along the coast and islands of British Columbia, except the Queen Charlotte Islands, through western Washington to northern Oregon. In the Cascade Mountains the range extends south from British Columbia to southern Oregon (43° N. latitude). It also is found locally in northwestern California. Pacific silver fir is considered a slow migrator and the time lapse since glacial recession may have been too short for the species to fully occupy its potential range (*18*).[1]

Pacific silver fir attains its greatest development on lower west and south slopes of the Olympic Mountains, west slopes of the Cascades, foothills of the lower Columbia River region, and the west coast of Vancouver Island.



F–506557

The range of Pacific silver fir.

HABITAT CONDITIONS

Climate

Climatic conditions within the Pacific silver fir range are marine in character with temperature influencing species distribution more than precipitation. The northern limits of Pacific silver fir probably coincide with the average growing season isotherm of 55° F. (*2*). However, this figure may be too high because the species grows on Vancouver Island from sea level to an elevation of 5,000 feet, where mean temperature at sea level is only 53.4° during the growing season (*18*).

The Pacific Silver Fir—Hemlock Type is best represented in the coastal fog belt and interior valleys characterized by a cool, wet climate (*8*). In general the range of Pacific silver fir is within the humid and superhumid zones. The climate is characterized by moderate temperatures with moderate daily and seasonal variation, and by a long growing season with a contrasting short, late-summer dry period.

Soils and Topography

Pacific silver fir grows on many soil types inherent to mountainous regions that have recently undergone complex glacial activity. The most

[1] Italic numbers in parentheses refer to Literature Cited, p. 34.

productive sites are well-drained, deep soils having abundant but not excessive moisture. The least productive sites are poorly drained. The species also grows on soils where thick humus layers have developed and nearly all the roots may be confined to these layers (*18*).

The pH of soil and humus samples beneath silver fir stands was found to be: A_0 horizon, 3.8; 0- to 2-inch depth, 4.4; 8- to 10-inch depth, 5.01 (*21*).

In southeast Alaska, Pacific silver fir grows from sea level to 1,000-foot elevation (*22*). Altitudinal limits rise southward from 1,000-foot elevation at the Alaska border to 5,000 feet on Vancouver Island. In Washington, the species is found near sea level on the west side of the Olympic Range. Growth is better above 1,500-foot elevation and good stands occur up to 4,500 feet (*8*). It occurs in the Cascade Ranges of Washington at medium to high elevations of 800 to 5,500 feet and is very common at 2,000 to 3,500 feet near Mount Rainier (*17*). The species is abundant in Oregon between 2,000 to 6,000 feet as far south as the divide between the Rogue and Umpqua Rivers north of Crater Lake (*4*). It is most abundant on the west slope of the Cascade crest at high elevations, but also occurs on the east side (*4*).

Associated Trees and Shrubs

Pacific silver fir occurs in both the Canadian and Hudsonian Life Zones, with best development in the former. It is a major component of the Pacific Silver Fir—Hemlock Type (Type 226) and occurs also in the following types:

Type No.	*Type*
205	Mountain Hemlock—Subalpine Fir
223	Sitka Spruce
224	Western Hemlock
225	Sitka Spruce—Western Hemlock
229	Pacific Douglas-Fir
230	Douglas-Fir—Western Hemlock

In addition to the species named in the type descriptions, Pacific silver fir may grow with Alaska-cedar, white bark pine, western larch, western white pine, lodgepole pine, grand fir, California red fir, Engelmann spruce, and noble fir.

Among the chief shrub associates on the Olympic peninsula (*14*) are the following:

Canadian zone: ovalleaf whortleberry (*Vaccinium ovalifolium*), big whortleberry (*V. membranaceum*), Oregon wintergreen (*Gaultheria ovatifolia*), snow dewberry (*Rubus nivalis*), rusty menziesia (*Menziesia ferruginea*), Arizona mountain-ash (*Sorbus dumosa*), vine maple (*Acer circinatum*), and Sitka alder (*Alnus sinuata*).

Hudsonian zone: common juniper (*Juniperus communis*), Sitka alder, mapleleaf currant (*Ribes acerifolium*), western mountain-ash (*Sorbus occidentalis*), myrtle pachistima (*Pachistima myrsinites*), bearberry (*Arctostaphylos uva-ursi*), rusty menziesia, Utah honeysuckle (*Lonicera utahensis*), and bush cinquefoil (*Potentilla fruiticosa*).

LIFE HISTORY

Reproduction and Early Growth

Flowering and fruiting.—The average dates for pollination and vegetative bud bursting at various points in Washington and Oregon are:

Phenological Event	*Dates*
Pollination begins	Apr. 19 to May 5
Pollination ends	May 2 to May 17
Vegetative buds burst	May 4 to May 22

There may be a relationship between high July temperatures of one year and the abundant dispersion of pollen the succeeding year.[2] The accumulation of degree-hours above a threshold value may also be important in initiating pollen dispersal in the spring. At a 1,000-foot elevation in British Columbia in 1959, pollen dispersal began on May 20—the male cones requiring 1,300 to 1,400 degree-hours above 50° F. Current weather conditions greatly influence the duration of pollen release. At a 1,500-foot elevation in British Columbia, the pollen period for Pacific silver fir lasted 14 days—from May 19 to June 1; however, 80 percent of the pollen was released in a 4- to 5-day period.

Seed production and dissemination.—Little is known of the initial, optimum, and oldest seed bearing ages of Pacific silver fir. The species probably begins to produce seed at age 20; good seed crops occur every 2 to 3 years.

Seed dissemination begins when the scales of the mature cone fall away and the large winged seeds are released. In Washington and Oregon, this usually happens from August 23 to September 19.

Dissemination of Pacific silver fir seed is mostly by wind. Because the seeds are moderately large (8,200 to 14,900 per pound), they are seldom carried any great distance from the parent tree. In still air the seed falls about 4.95 feet per second (*19*). Dissemination of seed by small mammals and birds is probably insignificant.

Cutting tests of Pacific silver fir seeds give a range of 6.7 to 35.0 percent of filled seed per cone, with cones from any given tree containing approximately the same percentage of filled seed (*26*). Cones collected at 2-week intervals at an altitude of 4,500 feet contained no viable seed until September 21 (*27*).

Seedling development.—Under normal conditions, seeds of Pacific silver fir germinate in the spring following a winter layover period on the

[2] Ebell, L. F., and Schmidt, R. L. The influence of meteorological factors upon dispersal of coniferous pollen on Vancouver Island, British Columbia. 1961. (Unpublished manuscript, British Columbia. Forest Service, Research Division.)

ground. Moist duff, moss-covered humus, and mineral soil are all equally favorable media for seedling establishment. Pacific silver fir seed will germinate on snow but few of these seedlings will become established (*20*).

Moderate to heavy shade is not adverse to early survival. But, though the species can reproduce under heavy shade, growth of seedlings under such conditions is extremely slow. During initial stages of establishment, the seedlings are probably more susceptible to unfavorable effects of climate and competing vegetation than to disease, insects, and small mammals.

Vegetative reproduction.—In nature, regeneration of Pacific silver fir is entirely by seed. No research has been reported on propagation of the species by cuttings or by grafting.

Sapling Stage to Maturity

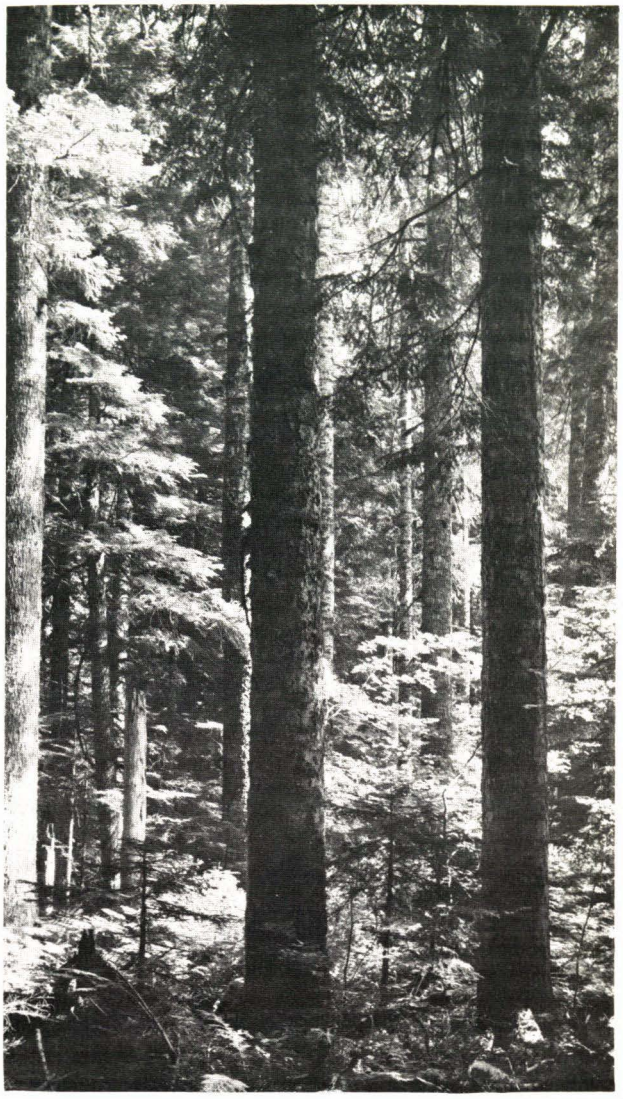
Growth and yield.—Pacific silver fir seldom grows in pure stands, except in small groups; consequently, little information exists in regard to growth and yield of the species. In some overmature climax types, where it occurs in approximately equal proportion with western hemlock, total volumes per acre for both species may exceed 70,000 board feet per acre on good sites.

Individual trees attain maximum heights of about 200 feet and occasionally have diameters over 6 feet. The largest specimen currently on record, in the Olympic National Park, Wash., measures 8.4 feet in diameter at breast height and is 245 feet tall (*7*). The species is a moderately slow grower and frequently reaches a diameter of only 2 feet at 200 years. The maximum known age was 540 years for a tree on Vancouver Island (*18*).

Reaction to competition.—Pacific silver fir is classed as a tolerant species (*3*). In British Columbia it is considered as tolerant of shade as western hemlock and western redcedar (*41*). It responds in both height and diameter growth when released and freed of root competition. Trees growing suppressed for from 70 to 100 years, and only 2 to 3 inches in diameter and 10 to 15 feet tall, show an exceedingly good response (*1*, *9*, *12*, *18*).

Pacific silver fir rather than western hemlock may be the true climax for most of the region west of the Cascades and in the Olympics. Where severe fire or windthrow has not taken place for 500 years or more, the climax appears to be an uneven-aged stand of Pacific silver fir (*10*).

Principal enemies.—Until quite recently, Pacific silver fir was thought to have few serious insect enemies, although a number of minor insect pests were known. Insects that killed individual trees were identified as the flatheaded fir borer (*Melanophila drummondi*) and the silver fir beetle (*Pseudohylesinus grandis*).



F–437609

A group of pure Pacific silver fir on the Mt. Baker National Forest.

An extensive outbreak of bark beetles leading to killing of Pacific silver fir was reported in 1950 (*11*). The outbreak, which spread over western Washington and northwestern Oregon, began in 1947 and reached a peak in 1954 (*28*). During this epidemic it became evident that the fir root bark bettle (*Pseudohylesinus granulatus*) equalled or exceeded *P. grandis* in destructiveness.

In 1954 another insect, the balsam woolly aphid (*Chermes piceae*), was discovered killing Pacific silver fir in southwestern Washington. Introduced into Nova Scotia from Europe in about 1900, the insect spread to the Pacific Northwest where it is now the most destructive insect attacking Pacific silver fir (*16*). Severe swelling of the branch tips, heavy branch killing, and sparse

foliage characterize trees dying from crown infestations—with Pacific silver fir dying from the top down. Stem infestations also occur, often killing trees within 2 to 4 years after initial attack (*25*).

Susceptibility to insect infestations apparently increases with tree age and at a given age the fastest growing trees are the most susceptible (*24*). Natural control rather than silvicultural or chemical control is more effective in suppressing an aphid infestation. Local predators and parasites are not effective, necessitating the importation and colonization of foreign predators (*13*, *15*, *23*, *25*).

Decay as a result of logging injuries, windthrow, and insect damage often occurs in Pacific silver fir. A study of the extent of heart rot in scarred advanced regeneration of silver fir, 8 to 9 years after release by logging, revealed only one small scar infected with wood-rotting fungi. This scar was completely healed (*1*). However, in a study of a mature and overmature silver fir-hemlock stand, almost two-thirds of the infections occurred through scars (6).

Twenty-one wood-destroying fungi are associated with decay in living trees (*5*). Of these, the trunk rots *Stereum sanguinolentum* and *Echinodontium tinctorium* caused 87 percent of the decay. Of the total loss, 10.8 percent was associated with the root and butt rots—*Poria subacida* and *Polyporus abietinus* were the most prevalent of this group. *Polyporus sulphureus*, *Stereum abietinum*, and *Hydnum abietis* are also common (*6*).

These studies indicated no relationship between decay and rates of growth, but did show a definite relationship between age and decay. Decay volume ranges from 0 percent at 75 years to 11.3 percent at 275 and 39.6 percent at 375 years. Up to 300 years of age, fir was more resistant than hemlock. Beyond that age incidence of decay is greater in fir; all trees over 400 years old are infected (*6*).

The shallow root system and thin bark of Pacific silver fir provide little resistance to severe windstorms or fire. Because hemlock and silver fir usually grow and develop for a major part of their lives in the protected understory, their root systems are not adapted to withstand the windstresses which occur in clear-cut perimeters within the coastal forests. They are less windfirm than Douglas-fir and western redcedar (*9*).

RACES AND HYBRIDS

No racial distinctions have been made within the Pacific silver fir species. Because of the extensive range of the species, however, it is reasonable to presume there may be racial variations.

Revised from "Silvical Characteristics of Pacific Silver Fir," by Edward J. Dimock II, U.S. Forest Serv. Pacific Northwest Forest and Range Expt. Sta. Silvical Ser. 4, May 1958, 12 pp. (With later revision by Jerry F. Franklin of the same station.)

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